DLA-92-P10014

MODEL TO ANALYZE CARRIER'S BIDS FOR THE REGIONAL FREIGHT CONSOLIDATION CENTER WORKLOAD

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OPERATIONS RESEARCH AND ECONOMIC ANALYSIS OFFICE

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DLA-LO

FOREWORD

This report documents the simulation model developed for the Defense Logistics Agency (DLA) Directorate of Supply Operations, Transportation Division (DLA-OT) to use for the RFCC commercial bid evaluation and the RFCC workload analysis.

I wish to thank the Regional Freight Consolidation Center (RFCC) Program Office (DLA-OTC) for their efforts in completing this model. It should prove to be a more effective tool in the carrier selection process and should result in lower overall transportation costs to DLA.

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Assistant Director
Policy and Plans

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The Defense Logistic Agency (DLA) Directorate of Supply Operations, Transportation Division (DLA-OT) requested the DLA Operations Research and Economic Analysis Management Support Office develop a bid evaluation model. This model was needed to evaluate rates submitted in reponse to the Guaranteed Traffic (GT) solicitation for the South Central and Southeast Regional Freight Consolidation Center (RFCC) regions.

The continental United States is divided into 11 different RFCC regions. Each of the current six DLA depots has its own region with the remaining five regions set up for commercial RFCCs. The technique used for the bid evaluation model was simulation. Simulation was selected for two major reasons; the current distribution system will be changed and historical data does not exist for the RFCC distribution system for the South Central and Southeast regions. A simulation model was developed to simulate both the existing distribution system and the proposed RFCC site.

The model inputs consist of depot processing time distributions, transit time distributions, Guaranteed Traffic rates, depot missed consolidation percentages, and carrier bid submissions.

One portion of the model simulates the depots building shipments direct to the customer. The other portion simulates the depots building shipments to the RFCC site and then the RFCC site building shipments to the customer. The model was validated by comparing the direct shipment portion with actual Freight Information System file data covering the same time period. A comparison of the model's direct shipment cost with the RFCC costs determines the cost effectiveness of the carrier.

The model was then used to evaluate the South Central and the Southeast RFCC bid solicitation under DLA-LO project number DLA-XX-P10015, Bid Evaluation for the Regional Freight Consolidation Center (RFCC) Southeastern and South Central Regions. The results showed that the South Central region was not cost effective, that the combined regions were not cost effective, and that only one carrier in the Southeast region was marginally cost effective.

This report recommends using the simulation model and results to evaluate RFCC bids for commercial pooling operations and to analyze operational issues concerning the commercial RFCC pooling operations.

SECTION 1
INTRODUCTION

The Defense Logistics Agency's (DLA) Operations Research and Economic Analysis Management Support Office (DORO) was tasked by the DLA-OT to develop a model to analyze carrier's bids for the Regional Freight Consolidation Center (RFCC) workload.

1.1 BACKGROUND

The principal purpose of the Regional Freight Consolidation Program is to reduce transportation cost while simultaneously maintaining the required level of customer service. The RFCC Program saves transportation dollars by consolidating vendor less-than-truckload (LTL) shipments in a region at an RFCC into truckload (TL) shipments to the DLA Depot and by pooling customer LTL shipments at the DLA Depot into TL shipments to a RFCC located in the region where the customers are located. The continental United States is divided into 11 different RFCC regions. Each of the current six DLA depots has its own region with the remaining five regions set up for commercial RFCCs. The commercial RFCC regions are contracted out to the "low cost" bidder. Consolidating and pooling operations within a region can be accomplished by the same contractor or separately by two different contractors.

The experience gained through two previous RFCC pooling contract awards has shown that a detailed analysis is required to insure the bids are reasonable and cost effective. Each region is unique depending on volume and regional guaranteed transportation rates along with location of customers and the RFCC. The bid evaluation analysis must be able to compare the existing distribution system with the RFCC distribution system to determine if the RFCC is cost effective for a given region. Using information generated by the bid evaluation analysis, DLA management and the "low cost" carrier can determine what additional action, if any, is required for the RFCC site to become cost effective along with delivering the shipment within the required time. Appendix B has a detailed comparison between the current and RFCC distribution systems to give you a better appreciation of the complexities involved in evaluating the bids.

1.2 SCOPE

(1) The bid evaluation analysis will be limited to the pooling side of the RFCC, i.e. shipments from the depot to the customer.

(2) The first leg costs from the depots to the proposed RFCC site and the current system costs will use current depot GT rates.

(3) The second leg costs from the proposed RFCC site to the customer will use the rates and transit times submitted by each carrier. These rates include the carrier's cost of operating the RFCC site.

(4) The total carrier RFCC cost is the sum of the first and second leg costs. Each carrier selects the location of the proposed RFCC site, therefore the first leg cost will vary depending on the location of the proposed RFCC site.

(5) The data used in the bid evaluation will consist of the same 6 months of Materiel Release Order (MRO) data provided in the bid solicitation package sent to the carriers by the Military Traffic Management Command (MTMC). Only Issue Priority Group (IPG) 3 and RFCC eligible material will be used.

(6) The RFCC hold time and transit time to the customer will be based on the carrier bid submission.

(7) The distributions used for depot processing and transit times will be based on historical data.

1.3 OBJECTIVE

Develop a model which can be used for current and future commercial pooling RFCC sites bid evaluations and can generate useful information for both DLA management and the carriers. The model must compare the pooling bid with the current distribution costs to determine the cost effectiveness of the bid.

SECTION 2
METHODOLOGY

The cornerstone to calculating the costs between the current and RFCC distribution systems and generating useful information concerning the pooling bids is a simulation model. Although the costs associated with the current system were known, the RFCC pooling concept was new in the South Central and Southeastern regions and no historical data existed to make estimates of the RFCC costs. The RFCC needed to be simulated to generate the number and types of shipments being put together at the depot and the RFCC so that the shipping rate bids could be applied to them. To make a direct comparison between the two systems and to validate the model, the current system was also simulated and compared to the known cost along with the RFCC cost for each bidder.

With the simulation model playing a key role in the study, it is important that you understand the approach that was taken in creating the model. First, issues and data analysis critical to the model were thoroughly defined and resolved. Second, the actual simulation program was built. Finally, the model was verified and validated using the current distribution system.

2.1 ISSUES AND DATA ANALYSIS

The central issue is building shipments at the various sites for the different scenarios. In the current system, shipments at the depots need to be built for direct delivery to the customer. In the RFCC system, shipments at the depots need to be built for delivery to the RFCC site and then rebuilt at the RFCC site for delivery to the customer. Once these shipments are built, it is just a matter of applying the appropriate shipping rate to obtain the costs. The issues and data analysis are therefore all centered around building these shipments properly.

The four issues and associated data analysis that are critical to successfully simulate the building of the shipments are: (1) identifying the requisitions eligible for the RFCC; (2) utilizing the proper distribution for the total processing time at the depot or RFCC site; (3) determining the appropriate distribution for the transit times; and (4) calculating of the depot missed consolidation percentage.

2.1.1 REQUISITIONS ELIGIBLE FOR THE RFCC

The RFCC distribution system was created to save money for less-than-truckload shipments out of the depot which must be transported directly to the customer. It can be less expensive to pool the customer shipments for a region into truckload shipments for most of the distance and break out less-than-truckload shipments for the final short leg to the destination. Data was selected from the depot MRO files and screened for eligibility for the RFCC Program. MROs are eligible for the RFCC Program if they fall into the following categories:

(1) All requisitions received for a given Department of Defense Activity Address Code (DoDAAC) customer for a given day that are less than 10,000 pounds and over 30 pounds.

(2) Non-hazardous commodities.

(3) MROs shipped via modes closed van, trailer-on-flatcar, small parcel.

(4) Downgraded Issue Priority Group (IPG) 1 and 2, and 3 requisitions.

2.1.2 TOTAL DEPOT AND RFCC PROCESSING TIME

As stated previously the RFCC processing time is submitted by the carrier. The processing time varies not only by the different carriers but also within the same carrier depending on customer locations. Although the number may vary, it is explicitly defined in number of days by each carrier.

On the contrary, the total depot processing time is more complex. The total depot processing time is the sum of the bank time, pick and pack time, and hold time which varies not only by item, but also number of items being shipped. To accurately simulate the total processing time, a probability distribution was generated from the historical MRO data file for each of the times defined below:

(1) Bank time = depot drop date - depot receipt date

(Based on RFCC eligible MROs to a geographical area since shipments are dropped based on geographical area)

(2) Pick and Pack time = offer to transportation date - depot drop date

(Based on all MROs since there is some interaction and mingling between the various geographical areas during the pick and pack process)

(3) Hold time = ship date - offer to transportation date

(Based on all MROs since there is interaction between the various geographical areas)

Although the three distributions for the above times can be generated and the appropriate distribution used in the model to answer "what if" questions in the future, the total processing time was found to be effective and simpler to use in the model.

(4) Total Processing Time = ship date - depot receipt date

(Based on all MROs)

The total depot processing time data was generated from historical data. Using the mean, standard deviation, skewness, kurtosis (another parameter to measure the skewness from the normal curve), and range of the data, the lognormal distribution was the best distribution to represent the total processing time.

2.1.3 TRANSIT TIMES

As with the RFCC processing time, the transit time from the RFCC to the customer is submitted in the carrier's bid. Again this will vary among carriers and within carriers depending on the location of the customers.

There is a major difference between TL and LTL transit times. Due to these variances the historical data for the TL and LTL times from the depot were examined to find the appropriate distributions to use in the model. The two transit time distributions identified and used in the model were the normal distribution and the lognormal distribution. As in the total processing time, the distributions were devised using the means, standard deviations, skewness, kurtosis, and ranges from the respective TL and LTL historical data. The process of deriving these distributions is explained in detail in Appendix C.

2.1.4 MISSED CONSOLIDATIONS

Pooling shipments at the depots for the RFCC can be done quickly and efficiently by the model, and also in the depot itself since

there are only a few RFCC sites. It is another story when it comes to consolidating shipments to the customers directly from the depot. Things such as workload leveling, human error, etc. contribute to the fact that the depot consolidation process is less than optimal. Therefore, a parameter must be added to the model to make it reflect reality in this area. The term "missed consolidation percentage" (MCP) was created and defined as the opportunity lost for a unit of freight to be combined with freight going to the same customer on the same day or consecutive days. The MCP was calculated from historical data for each transportation offer date to customers in a particular RFCC region for each depot. The weighted mean MCP was calculated for each depot to a particular RFCC based on the number of Government Bills of Lading (GBLs). The specific details in deriving the MCP and weighted mean MCP are in Appendix D.

2.2 MODEL DEVELOPMENT

The main purpose of the model is to evaluate the carrier bids for a proposed RFCC region. The model accomplished this by simulating the transportation system from the depot receipt date to the delivery of the shipment to the customer. Two scenarios were modeled. The current system in which shipments are made directly to the customer from the depot and the RFCC system. The model determines the costs for each scenario, ranks the carriers starting with least cost carrier, compares the carrier costs with the current system costs, and provides additional information concerning the proposed RFCC site. The additional information provided by the model will be able to answer the following questions:

(1) When might surges occur at the proposed RFCC site and the magnitude of those surges?

(2) On what day of the week may the surges occur?

(3) How often do these surges occur?

(4) What is the number of trailers arriving at the RFCC?

(5) What is the total weight arriving at the RFCC?

(6) What is the output classified by shipment size at the RFCC site?

(7) What is the distribution by shipment size out of the RFCC?

(8) What is the average number of customers served per day per Standard Point Location Code (SPLC)?

The above information will help the "low bid" carrier to have a better handle on his required RFCC workload. This is important since MTMC allows the "low cost" carrier to validate their submitted rates before allocating the traffic to the carrier. On occasion carriers have misinterpreted the bid solicitation and did not provide satisfactory service which was detrimental to the government.

The model preprocessed data, created data files, incorporated rate tables, utilized Statistical Analysis System (SAS) routines, and ran original programs to accomplish the above. For those who are interested in the specifics of the model, please refer to Appendix E.

2.3 VERIFICATION AND VALIDATION

2.3.1 VERIFICATION

The model was verified as it was developed. After each program and routine was created, the results were examined and found to be reasonable. The model was operating as designed.

2.3.2 VALIDATION

The model was validated by comparing the best estimate of actual cost to the model's cost of the current system for South Central and Southeast regions during the period covered in the actual bid solicitation. Although the Freight Information System (FINS) file contains most of the actual cost data, it had to be adjusted to eliminate the hazardous material shipments and accessorial charges, and increased to account for shipments under 70 pounds which are not included in the file. This comparison between the model and the adjusted FINS file for each region is given in Table 2-1 below and a detailed derivation is given in Appendix F.

Table 2-1. Adjusted FINS VS Model

	SOUTH CENTRAL REGION		SOUTHEAST REGION		
	WGT (LBS)	CHARGE ($)	WGT (LBS)	CHARGE ($)	
ADJ FINS TOTAL	19,268,149	1,971,245	15,744,842	1,319,207	
SIM TOTAL	19,268,145	2,114,398	15,744,843	1,347,477	
DIFFERENCE	4	(143,153)	(1)	(28,270)	%
DIFFERENCE		(6.77)		(2.10)	

With the differences of 6.77 percent in the South Central Region and 2.1 percent in the Southeast Region, the model was validated and ready to be utilized.

SECTION 3
FINDINGS

The findings are a result of applying the model to the bid solicitation package issued by MTMC, July 1, 1991, Guaranteed Traffic Solicitation (GT-R-91-35), allocating government traffic requirements for the establishment of RFCCs for the Southeast and South Central regions.

3.1 RANKING OF CARRIERS

The carrier's bids from least to high cost for each region were ranked and delivered to DLA-OT. The results are not attached due to the sensitivity of this information.

3.2 CARRIERS' BIDS VS CURRENT SYSTEM

There was only one carrier in the Southeast region that was cost effective, while there were no carriers cost effective in the South Central region. All the rest of the carriers were more expensive than the current system.

3.3 ADDITIONAL INFORMATION

The low bid carrier was given information on surges, workload, stop offs, and some sensitivity analysis. As a footnote to the benefit of this additional information, the low cost bidder realized that he miscalculated the workload and would not accept the allocation of traffic at his original bid submission price.

3.3.1 SURGES

The model identified the capacity needed for the surges and when they occurred. Typically, these surges occurred after long weekends due to holidays. For example, the Tuesday after Labor Day weekend produced the largest surge.

3.3.2 WORKLOAD

The carrier was given the number of trailers and number of pieces received per day from the depots. In addition, the workload was broken down for the inbound freight, outbound freight, and across the dock freight on a per day basis.

3.3.3 STOP OFFS

Another piece of information that was helpful to the carrier was the number of stop offs per trailer especially in those SPLCs where there were multiple customers.

3.3.4 SENSITIVITY ANALYSIS

Further runs of the model were made to develop a cost savings confidence interval for the cost effective carrier. This interval showed that the low cost carrier's bid submission did produce cost savings.

SECTION 4
CONCLUSIONS

This model is an excellent tool for RFCC pooling bid evaluation to determine the cost effectiveness of motor carrier bid submissions. In addition, a number of operational issues can be analyzed prior to award and commencement of actual operations.

SECTION 5
RECOMMENDATIONS

- Use the model to evaluate RFCC bids for commercial pooling operations.
- Use the model to analyze operational issues concerning the commercial RFCC pooling program.

APPENDIX A
LIST OF ABBREVIATIONS

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Abbreviation	Definition
ADJ	Adjusted
CORR	Corrected
DCR	Destination Cross Reference code
DDCO	Defense Depot, Columbus, OH
DDMP	Defense Depot, Mechanicsburg, PA
DDMT	Defense Depot, Memphis, TN
DDRV	Defense Depot, Richmond, VA
DDTC	Defense Depot, Tracy, CA
DDOU	Defense Depot, Ogden, UT
DLA	Defense Logistics Agency
DLA-OTC	Regional Freight Consolidation Center Program Office
DoDAAC	Department of Defense Activity Address Code
FINS	Freight Information System file
GBL	Government Bill of Lading
GT	Guaranteed Traffic
IPG	Issue Priority Group
LBS	Pounds
LTL	Less-Than-Truckload
MCP	Missed Consolidation Percentage
MRO	Materiel Release Order
MTMC	U. S. Army, Military Traffic Management Command
RFCC	Regional Freight Consolidation Center
SAS	Statistical Analysis System
SIM	Simulation
SPLC	Standard Point Location Code
TCN	Transportation Control Number
TL	Truckload
UMMIPS	Uniform Materiel Movement and Issue Priority System
UPS	United Parcel Service
URVMC	Uniform Random Variable for Missed Consolidation
WGT	Weight

APPENDIX B
COMPARISON OF CURRENT DISTRIBUTION SYSTEM VS THE RFCC PROGRAM

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COMPARISON OF CURRENT DISTRIBUTION SYSTEM
VS THE RFCC PROGRAM

It is critical that one have a thorough understanding of the current distribution system, the RFCC Program and their differences to understand and appreciate the complexities of evaluating the carrier bids.

(1) Current System

Under the current system, depots ship direct to the customer regardless of the mode of shipment. From the time the depot receives an MRO to the time the customer receives the materiel is governed by Uniform Materiel Movement and Issue Priority System (UMMIPS) standard of 21 days. The depot has 21 days to bank, pick and pack, hold, and transport the materiel to the customer. Ideally, the computer bank is used to consolidate MROs into shipments so that when the computer bank drops the MROs, they will be picked and packed simultaneously and shipped together as a unit with the same Transportation Control Number (TCN). In reality, the computer is not used to adequately bank these MROs. Instead, the transportation hold area is used to stage and consolidate these shipments. Finally, the shipment is offered to a carrier.

(2) RFCC Concept

Under the RFCC concept, the depot consolidates multiple LTL shipments to different customers within an RFCC region into TL shipments to the RFCC site. The RFCC site will break down the larger TL shipments from all depots in a given time period into larger LTL shipments to each customer. The RFCC site must deliver to the customer within 7 days of the receipt of the shipment from the depot. The same 21 day UMMIPS standard holds from the time the depot receives a MRO to the time the customer receives the item; but, the depot now has a total of only 14 days to deliver to the RFCC site.

(3) Differences

The differences between the current system and the RFCC concept consist of a change in the depot processing time (21 days to the customer versus 14 days to the RFCC), shipment sizes out of the depot (LTL versus TL), and transit time (LTL transit times versus TL transit times). Table B-1 shows the differences between the two methods. Figure B-1 shows graphically the difference between the two methods for a depot to a given customer. The 7 days which the RFCC site has to consolidate shipments to the customer was removed from the total depot processing time in order to maintain the required customer service level.

Table B-1. Direct Depot Shipments VS RFCC

PROCESS	DEPOT SHIPMENTS TO CUSTOMERS	DEPOT SHIPMENTS TO RFCC SITE
UMMIPS to perceived customer	21 days	14 days
Depot Shipment sizes	LTL	Larger LTL and TL
Bank time	No change	LESS time
Pick and Pack	No change	No change
Hold	No change	No change
Total Depot Processing Time	No change	LESS time

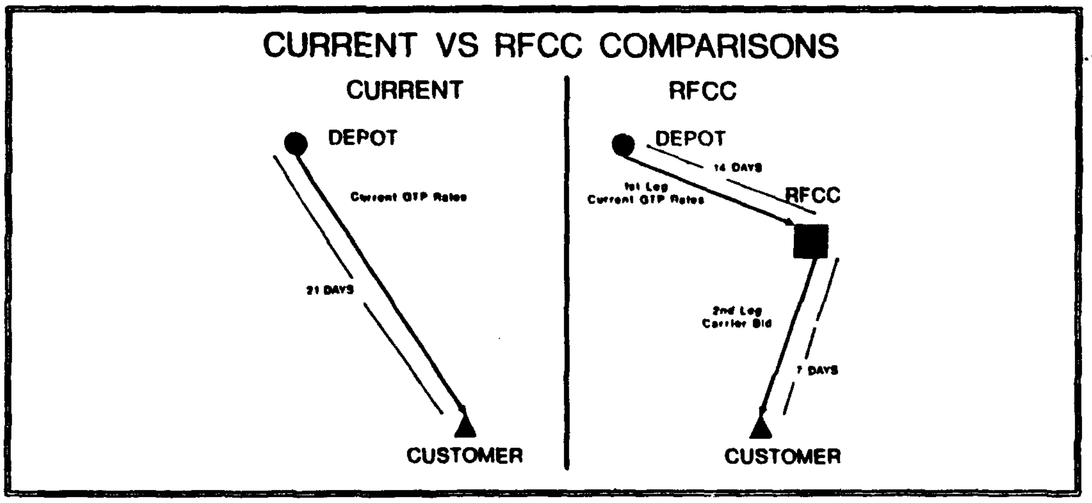

Figure B-1. Current VS RFCC Comparisons

APPENDIX C
ESTIMATING THE TRANSIT TIME DISTRIBUTIONS

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ESTIMATING THE TRANSIT TIME DISTRIBUTIONS

The transit time distributions utilized actual historical data from the depots to the specific 4 digit Standard Point Location Code (SPLC) in the Materiel Release Order (MRO) file. For the most part, the 4 digit SPLC was available in the file. When it was not, the 2 digit SPLC was used. In rare cases, the state or RFCC region had to be used. This hierarchy of aggregation was applied in order to maintain the maximum amount of fidelity in the model for the most frequent customers.

Due to the differences in the transit times for the Less-Than Truckload (LTL) and Truckload (TL) shipments, each had to be analyzed separately. Two techniques were used in determining the LTL and TL transit time distributions. One was to calculate the mean, standard deviation, skewness, kurtosis, and range of the historical data and apply these statistics to potential distributions. The other was to graph the historical data points on the same graph with the potential distributions.

Examples for Defense Depot, Memphis, TN (DDMT) and Defense Depot, Richmond, VA (DDRV) TL and LTL transit times to SPLC 4616 are given below. The two potential distributions used were the normal and lognormal distributions. The actual data is plotted using the square boxes, the normal distribution for the mean and standard deviation calculated from the historical data is plotted using the symbol "+", and the lognormal distribution for the mean and standard deviation calculated from the historical data is plotted by the line. The normal distributions were truncated at zero days because negative transit times cannot exist. The lognormal distribution is undefined for values less than zero. Both distributions had an upper bound of 21 days.

(1) Transit time distributions for DDMT are plotted in Figures C-1a and C-1b. Figure C-1a - LTL Transit Times for DDMT shows that the actual data fit a normal distribution. The mean was 7.83 days with a standard deviation of 2.81 days. Figure C-1b - TL Transit Times for DDMT shows that the data could fit either a lognormal or a normal distribution. The normal distribution had a mean of 3.94 days with a standard deviation of 1.76 days. The three standard deviation interval around the mean is from -1.34 days to 9.22 days. Since, the data appeared to more closely fit the lognormal distribution, the lognormal distribution was used.

(2) Transit time distributions for DDRV are plotted in Figures C-2a and C-2b. Figure C-2a – LTL Transit Times for DDRV and Figure C-2b – TL Transit Times for DDRV show that the distributions could be either normal or lognormal. The lognormal was used since the normal could produce negative transit times. Figure C-2a shows that there were more actual data points which laid on or closer to the lognormal curve for LTL transit times. The LTL transit time has a mean of 1.74 days with a standard deviation of 1.51 days. Over 12 percent of the time, a normal distribution would produce negative transit times.

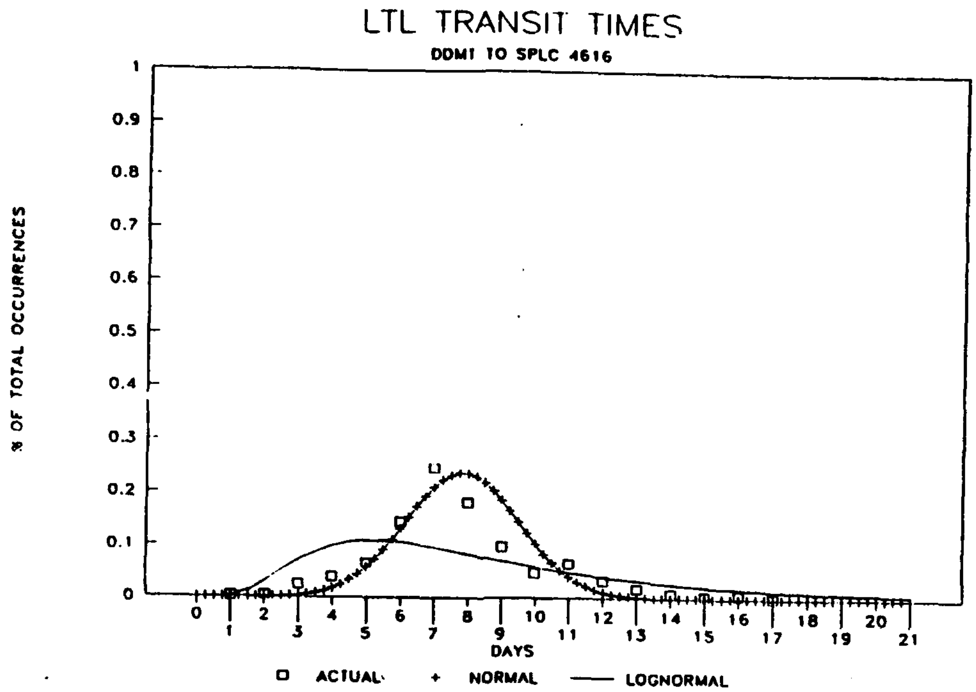

Figure C-1a

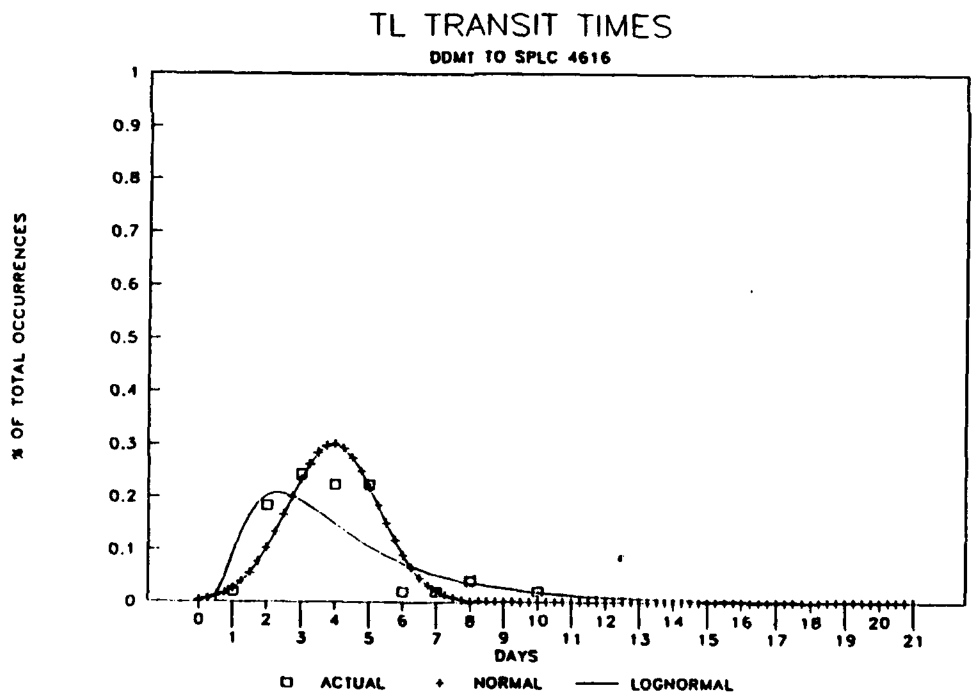

Figure C-1b

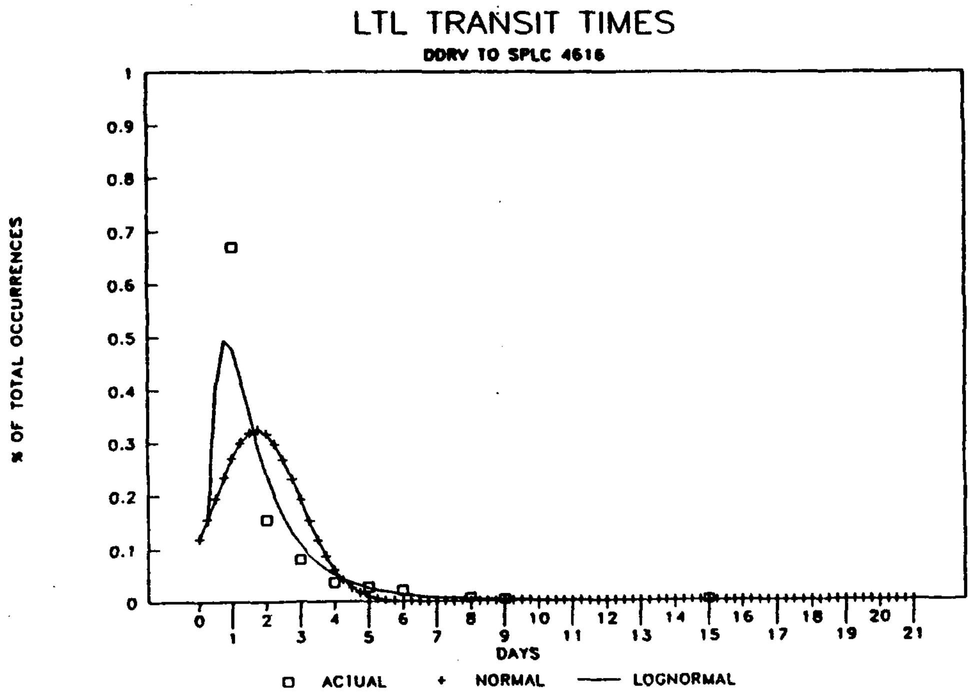

Figure C-2a

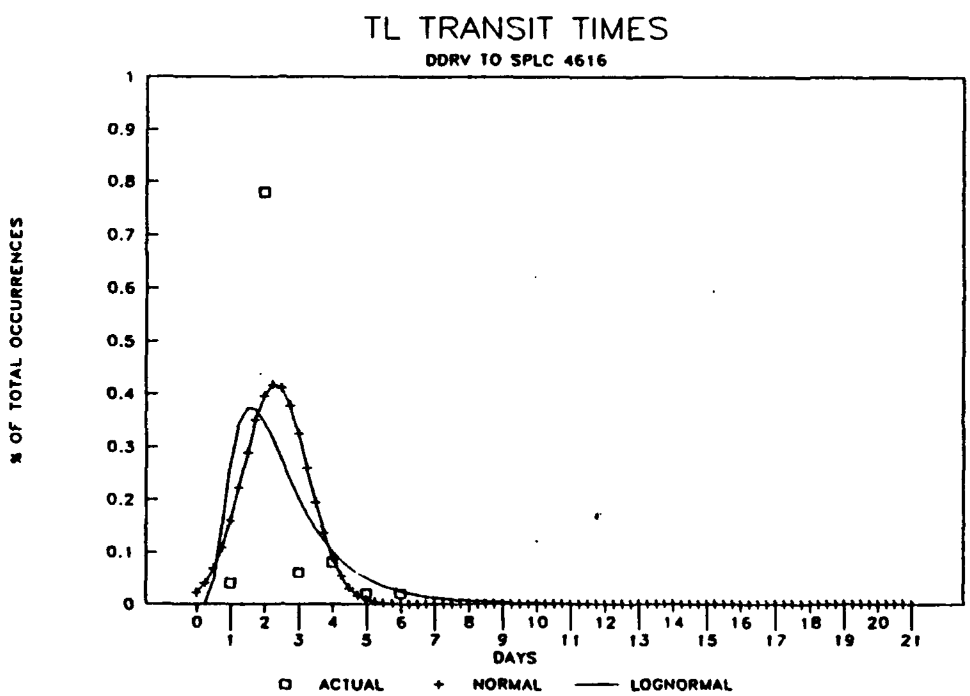

Figure C-2b

APPENDIX D
CALCULATING THE MISSED CONSOLIDATION PERCENTAGE

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CALCULATING THE MISSED CONSOLIDATION PERCENTAGE

The Missed Consolidation Percentage (MCP) was calculated by dividing the number of Government Bills of Lading (GBL) that should have been consolidated, but were not, by the total number of GBLs. These numbers were derived using information from the Materiel Release Order (MRO) file in the following manner. First, Transportation Control Numbers (TCN) were summed by GBL to determine the weight of the shipment. Those greater than 25,000 pounds were eliminated since they are considered TL. Second, the remaining GBLs were sorted by offer date to transportation and ship date. The number of GBLs offered between the offer date and the last ship date for each offer were summed. This assumed that all the GBLs offered between the offer date and the last ship date should have been consolidated into one GBL. Finally, the MCP can be calculated and would be:

$$MCP = \frac{(\text{Number of GBLS}) - 1}{(\text{Number of GBLS})} = 1 - (1/\ \text{Number of GBLs})$$

The MCP was calculated for each possible offer date. A possible offer date is the first offer date past the last ship date from the previous offer date. An examination of the offer date to transportation and ship dates revealed that some GBLs were being "held" in transportation for an excessive amount of time i.e. greater than 5 days. When there was excessive hold time the ship date was adjusted to be 5 days after the offer date to transportation.

A weighted mean MCP was calculated based on the number of GBLs. This MCP included instances where a single GBL was offered and shipped with no other GBLs offered during the period. Table D-1 shows the MCPs calculated for each depot by RFCC region.

Table D-1. Weighted Mean Missed Consolidation Percentages

DEPOT	SOUTH CENTRAL REGION	SOUTHEAST REGION
DDMP (Mechanicsburg, PA)	30.22%	36.06%
DDTC (Tracy, CA)	28.18%	21.97%
DDCO (Columbus, OH)	7.83%	10.28%
DDMT (Memphis, TN)	44.25%	46.96%
DDRV (Richmond, VA)	16.17%	31.09%
DDOU (Ogden, UT)	4.44%	8.65%

APPENDIX E
DETAIL MODEL FLOW EXPLANATION

APPENDIX E
DETAIL MODEL FLOW EXPLANATION

There are numerous multi-step programs used to develop the RFCC cost comparison. Four basic phases are followed. First, the data are analyzed and preprocessed. This accounts for the variability due to the random occurrences over time. The second phase builds shipments. Within the second phase, one set of programs simulate the flow of MROs through the depots to the customer. Another set simulates the flow through the depots to the RFCC and finally to the customer. The third phase of the RFCC comparison rates shipments from the depots to the customers and from the depot through the RFCC and then on to the customer. Finally, the shipment sets generated for the cost saving carriers are analyzed. This provides additional information concerning surge demands at the proposed RFCC site, workload requirements, etc. The order of execution of the various phases and programs is shown below.

E-1.1 DATA ANALYSIS AND PREPROCESSING

During the first phase, data were analyzed and processed in the following manner for input to the model:

(1) First 6 months of requisition data are pulled from the MRO file.

(2) Data are then summarized to meet the RFCC solicitation requirements.

(3) Using the most current 4 quarters of MRO data, depot processing time distributions are generated based on the geographical area.

(4) Using the most current 4 quarters of FINS data, transit time distributions are generated based on 4 digit SPLC, 2 digit SPLC, state and region for both TL and LTL.

(5) The 95th percentile for LTL transit time from the depot to the region are generated. This time is then subtracted from the UMMIPS standard of 21 days giving the maximum allowable depot processing time. The maximum allowable depot processing time is a constraint to ensure that all MROs are processed to meet the UMMIPS standard.

(6) Using the requisition set (E-1.1(1)), depot processing time (E-1.1(3)), LTL and TL transit times (E-1.1(4)) based on the destination SPLC are appended to the file.

Each record is treated as an MRO. Depot processing times are calculated by taking the actual depot tranceived date of the MRO and adding a depot processing time variable to determine a date offered to transportation. The depot processing time variable is calculated by using a random variable and the time distributions (E-1.1(3)) for each of the various depot processes. Transit times from the depot are calculated in the same manner. A random variable and the time distributions for TL and LTL times (E-1.1(4)) are used to append the TL and LTL transit times to the MRO.

(7) The missed consolidation percentages (see Appendix D) and uniform random variables are appended.

Missed consolidation is accounted for by using the missed consolidation percentage (MCP) for each depot. A uniform random variable for missed consolidation (URVMC) is appended to each record. When the shipments are being built in transportation the URVMC is checked. If the URVMC is less than the MCP then the MRO is not consolidated. The previous consolidated MROs are considered a shipment and at that time the consolidation process starts over.

Each MRO record contains an LTL and TL transit time determined by distribution type and a random variable. When a shipment is finished consolidating, the transit time from the last MRO in the consolidated shipment is used.

E-1.2 BUILD SHIPMENTS

The next step builds shipments for each of the various scenarios based on the following methodology.

(1) The "direct shipment" program builds shipments from the depot direct to the customer.

(a) The requisition data set is sorted by depot, DCR and offer date to transportation. Shipments to the DCR are built using each requisition that is offered. The maximum depot processing time (E-1.1(5)) based on the 95th percentile LTL transit time from the depot to the region is coded into the program. When the bank or processing time meets the TL weight limit the shipment is shipped using the TL transit time. When the processing

time meets the maximum allowable depot processing time the shipment is shipped as an LTL shipment using the LTL transit time. The MCP is used when the MROs are consolidating to be shipped from the depot.

(b) When shipments are scheduled to be shipped on a weekend or holiday, ship dates are adjusted to the next business day. If the arrival date to the DCR falls on a weekend or holiday, then the receipt date is adjusted to the next business day.

(c) Mileage and United Parcel Service (UPS) zones are appended to each shipment, as this data is needed to rate shipments from the depot direct to the customer.

(2) The "RFCC shipment" program builds shipments from the depot to the RFCC, appends carrier data and builds shipments from the RFCC to the customer.

(a) The requisition data set is sorted by depot and offer date to transportation. Shipments to the RFCC are then built using the individual MROs offered. Maximum depot processing time (E-1.1(5)) is based on the 95th percentile LTL transit time from the depot to the RFCC's 4 digit SPLC coded into the program. When the bank or processing time meets specified TL weight limit the shipment is made as a TL shipment. When the processing time meets the maximum allowable depot processing time the shipment is shipped as an LTL shipment. TL transit times are used for TL shipments and LTL transit times are used for LTL shipments.

(b) When a ship date falls on a weekend or holiday, the ship date is adjusted to the next business day. If the arrival date to the RFCC falls on a weekend or holiday, then the RFCC receipt date is adjusted to the next business day.

(c) The RFCC shipment set is sorted by the DCR SPLC and is matched to the carrier's bid data set by SPLC. The carrier's proposed rates and hold times are then appended.

(d) The appended RFCC shipment set is then sorted by DCR and RFCC receipt date. Shipments are built

from the RFCC to the DCR using the carrier's hold time and transit time. When a shipment is scheduled to be shipped on a weekend or holiday, the ship dates are adjusted to the next business day. If the arrival date to the DCR falls on a weekend or holiday, then the DCR receipt date is adjusted to the next business day.

E-1.3 RATE SHIPMENTS

Two separate programs are used to rate shipments for baseline and RFCC shipments. First, shipments are rated from depot direct to the customers (baseline) without moving through an RFCC. This is a relatively straightforward process. Second, shipments are rated through the RFCC, which includes rating both the first leg (depot to the RFCC) and second leg (RFCC to customer) freight movements. The following is a description of the RFCC rating process:

(1) Costs are first calculated for the second leg. This is done by simply aggregating the weight for each shipment from the proposed RFCC to the DCR and applying the carrier rates. This portion of the program can be modified to do sensitivity analysis on the carrier rates, i.e. increase/decrease small parcel rates, minimum charges, and/or freight rates. The statistical output consists of average minimum charge, average freight rate, average small parcel charge, number of shipments, total weight, shipment weights, etc.

(2) Costs are then calculated for the first leg. The program aggregates each shipment by depot and RFCC and appends the weight, weight group, mileage bracket and the GT rate for the proposed RFCC site. Finally, the RFCC shipment set is rated by depot. This produces statistical output consisting of average minimum charge, average freight rate, average small parcel charge, number of shipments, total weight, shipment weights, etc.

First and second leg costs are then summed to obtain an overall cost for the proposed RFCC site. The overall costs are then used to rank the carriers and to compare the carrier costs with the baseline.

E-1.4 CONFIDENCE INTERVALS

The results of a single run of the model for RFCC versus baseline routed shipments will provide some insight into a particular bid solicitation. Although a single run is not adequate to fully

evaluate carrier costs, high cost carriers can be eliminated up front so that more attention can be placed on the low cost carriers.

The low cost carrier or carriers should have multiple runs for comparison against multiple runs of the baseline. When this is done, a confidence interval is developed for both the carrier and the baseline. These confidence intervals will give a range within which the true costs lies. Each run of the model for confidence intervals should start with the program at section (E-1.1(6)). This program is used to generate different random numbers for depot processing times and transit times.

E-1.5 SAVINGS RANGE

The savings range compares the confidence intervals for the proposed RFCC site with the baseline. The lower bound for the cost savings is the high cost from the confidence interval of the RFCC site compared with the low cost from the baseline confidence interval. The upper bound for cost savings is the low cost from the confidence interval of the RFCC site compared with the high cost from the baseline confidence interval.

E-1.6 ADDITIONAL ANALYSIS

Using the RFCC shipment sets generated in section E-1.2(2) throughput of the proposed RFCC is analyzed.

APPENDIX F
TOTAL WEIGHT AND CHARGE COMPARISONS FOR THE RFCC SOUTHEAST AND SOUTH CENTRAL REGION SIMULATIONS VERSUS FINS

APPENDIX F
TOTAL WEIGHT AND CHARGE COMPARISONS FOR THE RFCC SOUTHEAST AND SOUTH CENTRAL REGION SIMULATIONS VERSUS FINS

Analysis of Freight Information System (FINS) files for the 6-month period corresponding to Southeastern and South Central Regional Freight Consolidation Center (RFCC) bids yielded several results of value in the simulation model development and verification of the final simulation results.

Several major differences between the input data set constructed using Materiel Release Order (MRO) files and FINS must first be defined and understood. First, the total weight for the period from the two files does not correspond exactly due to the inclusion of small parcels between 30 and 70 pounds of all types in the MRO data which is only partially included in FINS. Second, FINS includes hazardous shipments which are excluded from the MRO data causing further discrepancies in weight. Third, many dedicated truck shipments are reflected in the MRO data, especially from the Memphis depot, which were coded A for TL or B for LTL rather than S for dedicated truck service. Those not readily identifiable were retained in MRO inputs. Fourth, there is a lag in reporting for both files and date fields are different making it even more impossible to match the data exactly. Lastly, there are numerous additional charges in the FINS data for hazardous, special handling, drop offs, security, and other requirements not computed along with normal line haul charges which are not computed by the the simulation. Overall, there is an estimated 7 percent non-applicable freight and a corresponding 10 percent of additional charges in the FINS data, primarily due to hazardous items and special handling charges, which would not be shipped through the RFCC system. Table F-1 gives a more accurate adjustment percentage breakdown by category of freight based on weights in FINS. For example, in the minimum charge category only 80 percent of the FINS entries less than 300 pounds and greater than or equal to 70 pounds are applicable to the RFCC which corresponds to approximately 75 percent of the total line haul charges.

Table F-1. Percentage Breakdown of FINS

	FREIGHT		MINIMUM CHARGE		SMALL PARCEL	
	WGT(Lbs)	CHG($)	WGT(Lbs)	CHG($)	WGT(Lbs)	CHG($)
PERCENT:	95	93	80	75	75	70

However, the total amount of freight in FINS versus MRO data must also be accounted for to obtain an accurate comparison. A simple ratio of the FINS weight, after adjustment by the percentages given above, to the MRO total provides a good correction factor (CF) for the overall comparison.

This method renders a CF of 1.455396 for the South Central region and a CF of 1.148690 for the Southeastern region. Specifics of this procedure are as shown in Table F-2. Tables F-3 and F-4 show a comparison of each region by category of freight using the adjustment table and the CFs. Please note that there is not an exact corroboration between the comparisons since the CF is done for the total weight by region and adjustments are made by category in an attempt to be as accurate as possible. Missed depot consolidation found in the historical data which is not captured by the simulation using MRO data does not allow a valid CF to be determined by category since weight is significantly shifted between categories due to the missed consolidations. Therefore, the adjusted weights and charges by category are applied and the overall CF for the region is used to obtain the best estimates. This method actually gives the best estimate of true historical costs by category and reflects the difference due to the missed consolidation. This becomes apparent when you study Tables F-3 and F-4 in more detail.

Table F-2. Total Weight and Charges From Each Depot By Region

DEPOT	STAT	DALLAS/SC WGT(Lbs)	DALLAS/SC CHG($)	JACKSONVILLE/SE WGT(Lbs)	JACKSONVILLE/SE CHG($)
BJSQ	SUM	1,302,039	164,179.33	3,436,772	300,912.41
	MEAN	654	82.46	822	71.97
	MIN	30	4.15	30	3.50
	MAX	9989	3,124.20	9892	1,042.00
DMSQ	SUM	1,754,332	238,704.40	2,835,850	267,637.48
	MEAN	534	72.71	796	75.14
	MIN	30	4.15	30	2.75
	MAX	9031	3,378.12	9809	1,818.29
EISQ	SUM	723,236	90,241.47	825,523	109,102.20
	MEAN	576	71.91	520	68.66
	MIN	30	3.80	30	4.10
	MAX	9308	2,171.30	9892	3,422.00
FDSQ	SUM	7,030,754	655,574.29	6,068,690	395,238.11
	MEAN	880	82.06	1002	65.24
	MIN	30	2.22	30	1.65
	MAX	9993	3,420.00	9990	1,482.36
KASQ	SUM	2,217,196	206,584.19	748,533	85,539.54
	MEAN	927	86.40	672	76.79
	MIN	30	4.00	30	5.36
	MAX	9990	2,446.26	9639	2,233.00
LHSQ	SUM	1,208,046	149,649.10	823,106	117,620.17
	MEAN	676	83.70	555	79.31
	MIN	30	1.35	30	7.00
	MAX	9872	2,404.39	9465	2,554.00
FINS TOTAL		14,235,603	1,504,932.78	14,738,474	1,276,049.91
SIM TOTAL		19,268,145	1,379,646.00	15,744,843	926,280.00
DIFFERENCE		(5,032,542)	125,286.78	(1,006,369)	349,769.91
ADJ TOTAL		13,239,111	1,354,439.50	13,706,781	1,148,444.92
SIM TOTAL		19,268,145	1,379,646.00	15,744,843	926,280.00

Table F-2. Total Weight and Charges From Each Depot By Region (Continued)

	REGION			
	DALLAS/SC		JACKSONVILLE/SE	
	WGT(Lbs)	CHG($)	WGT(Lbs)	CHG($)
DIFFERENCE	(6,029,034)	(25,206.50)	(2,038,062)	222,164.92
CORR FACTOR	1.455396		1.148690	
CORR TOTAL	19,268,149	1,971,245.83	15,744,842	1,319,207.20
SIM TOTAL	19,268,145	1,379,646.00	15,744,843	926,280.00
DIFFERENCE	4	591,599.83	(1)	392,927.20
%DIFFERENCE		42.88		42.42

Table F-3. Total Weight and Charges From Each Depot By Shipment Type For The SE

DEPOT	STAT	SHIPMENT TYPE					
		FREIGHT		MINIMUM CHARGE		SMALL PARCEL	
		WGT(Lbs)	CHG($)	WGT(Lbs)	CHG($)	WGT(Lbs)	CHG($)
BJSQ	SUM	3,158,180	212,457.73	244,550	60,432.41	34,042	28,022.27
	MEAN	1,654	111.29	158	39.17	47	38.44
	MIN	300	5.10	70	3.50	30	3.50
	MAX	9,892	1,042.00	299	902.72	69	414.50
DMSQ	SUM	2,609,703	198,577.46	196,846	46,945.14	29,301	22,114.88
	MEAN	1,531	116.47	157	37.47	49	36.61
	MIN	300	8.01	70	2.80	30	2.75
	MAX	9,809	1,818.29	299	1,551.50	69	415.60
EISQ	SUM	694,887	65,713.67	118,548	33,427.10	12,088	9,961.43
	MEAN	1,188	112.33	155	43.58	51	42.03
	MIN	300	4.10	70	12.75	30	4.10
	MAX	9,892	3,422.00	299	422.23	69	87.59
FDSQ	SUM	5,709,956	331,671.46	311,611	43,188.43	47,123	20,378.22
	MEAN	1,848	107.34	158	21.83	48	20.58
	MIN	300	9.39	70	1.65	30	1.92
	MAX	9,990	1,482.36	299	288.12	69	280.87
KASQ	SUM	667,218	64,534.02	74,568	16,285.27	6,747	4,720.25
	MEAN	1,316	127.29	160	34.95	48	33.48
	MIN	300	5.36	70	30.00	30	30.00
	MAX	9,639	2,233.00	299	52.39	68	100.38
LHSQ	SUM	703,860	80,686.61	110,259	29,666.66	8,987	7,266.90
	MEAN	1,201	137.69	153	41.20	51	41.06
	MIN	300	7.00	70	37.00	30	37.00
	MAX	9,465	2,554.00	298	193.43	69	116.00
FINS TOTAL		13,543,804	953,640.95	1,056,382	229,945.01	138,288	92,463.95
ADJ TOTAL		12,866,614	886,886.08	845,106	172,458.75	103,716	64,724.77
SIM TOTAL		15,375,844	838,712.00	299,115	67,710.00	69,884	19,858.00
DIFFERENCE		(2,509,230)	48,174.08	545,991	104,748.75	33,832	44,866.77

Table F-3. Total Weight and Charges From Each Depot By Shipment Type For The SE (Continued)

	SHIPMENT TYPE					
	FREIGHT		MINIMUM CHARGE		SMALL PARCEL	
	WGT(Lbs)	CHG($)	WGT(Lbs)	CHG($)	WGT(Lbs)	CHG($)
CORR FACTOR			1.148690			
CORR TOTAL	14,779,751	1,018,757.18	970,764	198,101.64	119,138	74,348.69
SIM TOTAL	15,375,844	838,712.00	299,115	67,710.00	69,884	19,858.00
DIFFERENCE	(596,093)	180,045.18	671,649	130,391.64	49,254	54,490.69
%DIFFERENCE	-3.88	21.47	224.55	192.57	70.48	274.40

Table F-4. Total Weight and Charges From Each Depot By Shipment Type For The SC

DEPOT	STAT	FREIGHT WGT(Lbs)	FREIGHT CHG($)	MINIMUM CHARGE WGT(Lbs)	MINIMUM CHARGE CHG($)	SMALL PARCEL WGT(Lbs)	SMALL PARCEL CHG($)
BJSQ	SUM	3,158,180	212,457.73	244,550	60,432.41	34,042	28,022.27
	MEAN	1,654	111.29	158	39.17	47	38.44
	MIN	300	5.10	70	3.50	30	3.50
	MAX	9,892	1,042.00	299	902.72	69	414.50
DMSQ	SUM	2,609,703	198,577.46	196,846	46,945.14	29,301	22,114.88
	MEAN	1,531	116.47	157	37.47	49	36.61
	MIN	300	8.01	70	2.80	30	2.75
	MAX	9,809	1,818.29	299	1,551.50	69	415.60
EISQ	SUM	694,887	65,713.67	118,548	33,427.10	12,088	9,961.43
	MEAN	1,188	112.33	155	43.58	51	42.03
	MIN	300	4.10	70	12.75	30	4.10
	MAX	9,892	3,422.00	299	422.23	69	87.59
FDSQ	SUM	5,709,956	331,671.46	311,611	43,188.43	47,123	20,378.22
	MEAN	1,848	107.34	158	21.83	48	20.58
	MIN	300	9.39	70	1.65	30	1.92
	MAX	9,990	1,482.36	299	288.12	69	280.87
KASQ	SUM	667,218	64,534.02	74,568	16,285.27	6,747	4,720.25
	MEAN	1,316	127.29	160	34.95	48	33.48
	MIN	300	5.36	70	30.00	30	30.00
	MAX	9,639	2,233.00	299	52.39	68	100.38
LHSQ	SUM	703,860	80,686.61	110,259	29,666.66	8,987	7,266.90
	MEAN	1,201	137.69	153	41.20	51	41.06
	MIN	300	7.00	70	37.00	30	37.00
	MAX	9,465	2,554.00	298	193.43	69	116.00
FINS	TOTAL	13,008,793	1,148,551.19	1,069,733	246,730.09	157,077	109,651.50
ADJ	TOTAL	12,358,353	1,068,152.61	855,786	185,047.57	117,808	76,756.05
SIM	TOTAL	18,754,066	1,241,901.00	425,022	114,303.00	89,057	23,442.00
DIFFERENCE		(6,395,713)	(173,748.39)	430,764	70,744.57	28,751	53,314.05

Table F-4. Total Weight and Charges From Each Depot By Shipment Type For The SC (Continued)

	SHIPMENT TYPE					
	FREIGHT		MINIMUM CHARGE		SMALL PARCEL	
	WGT(Lbs)	CHG($)	WGT(Lbs)	CHG($)	WGT(Lbs)	CHG($)
CORR FACTOR			1.455396			
CORR TOTAL	17,986,298	1,554,585.02	1,245,508	269,317.49	171,457	111,710.45
SIM TOTAL	18,754,066	1,241,901.00	425,022	114,303.00	89,057	23,442.00
DIFFERENCE	(767,768)	312,684.02	820,486	155,014.49	82,400	88,268.45
%DIFFERENCE	-4.09	25.18	65.88	135.62	92.53	376.54

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This is the documentation of the simulation model developed to analyze carrier's bid submissions for commercial pooling at the Regional Freight Consolidation Centers (RFCCs). Pooling is defined as the consolidation of truckload shipments from the depots into large less-than-truckload lots for transshipment to the customer. The model simulates the current system to develop a baseline cost and the proposed RFCC system to develop a carrier total cost. The carriers are ranked from low cost to high cost and the costs are compared with the baseline to determine the carrier's cost effectiveness. Further analysis can be performed for the cost effective carriers to determine workload requirements. The model inputs consist of stochastic and deterministic data. The stochastic data includes depot processing time distributions, less-than-truckload and truckload transit time distributions. The deterministic data consists of the carrier's bid submissions - RFCC hold times and transit times and Guaranteed Traffic rates.

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